Water Harvesting and Climate Change Adaptation; the experience of Tigray region in Ethiopia

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Some thoughts:

- If there is surface water runoff in a catchment it is possible to create new water (surface and groundwater) or enhance existing sources.
- Despite rainfall variability and climate change we can create landscapes resilient to droughts/flooding and ensure food security.
- A catchment based integrated large-scale intervention is a key for: creating new water, ensuring food security, and climate change adaptation.
- ***Water Harvesting and Management*** should be one of the main landscape interventions.

Outline: Presentation

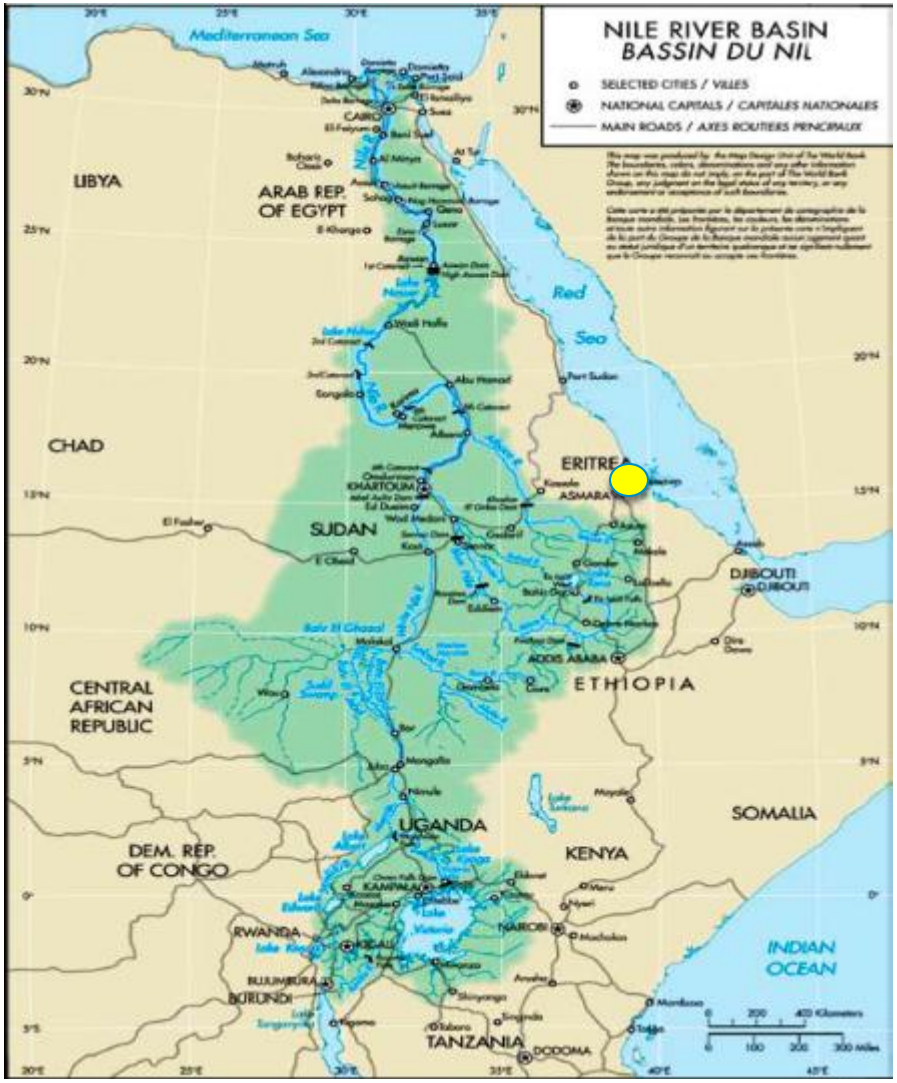
1. Definitions
2. Characteristics of Northern Ethiopia
3. Practices of Watershed Management in Northern Ethiopia
4. Techniques of Water Harvesting in Northern Ethiopia
5. Benefits of the interventions
6. Concluding remarks

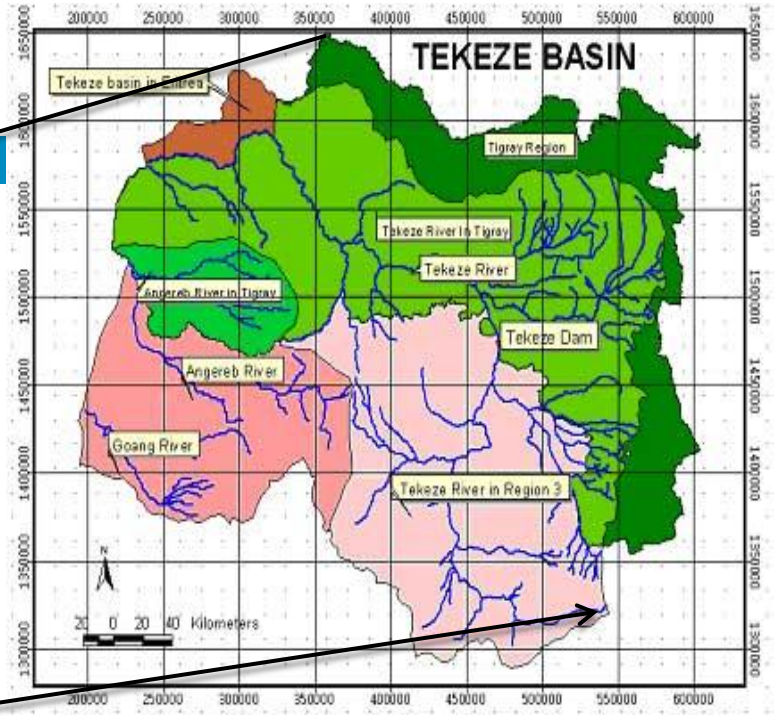
1. Definitions

- UNEP (2009) defines **rain water harvesting** as: “the collective term for a wide variety of interventions to use rainfall through collection and storage, either in **soil** or in man-made **dams**, **tanks** or **containers** bridging dry spells and droughts”.
- Water harvesting includes:
  - ***In-situ*** (also call water conservation), and
  - ***Ex-situ*** which uses water storage or retention component to store water from a certain catchment.

2. Characteristics of Tigray region, Ethiopia

- Most of the Tigray region is found in the upper course of the Nile basin, northern Ethiopia.
- Most of the smallholding farmers in the area depend on rainfed agricultural practices.



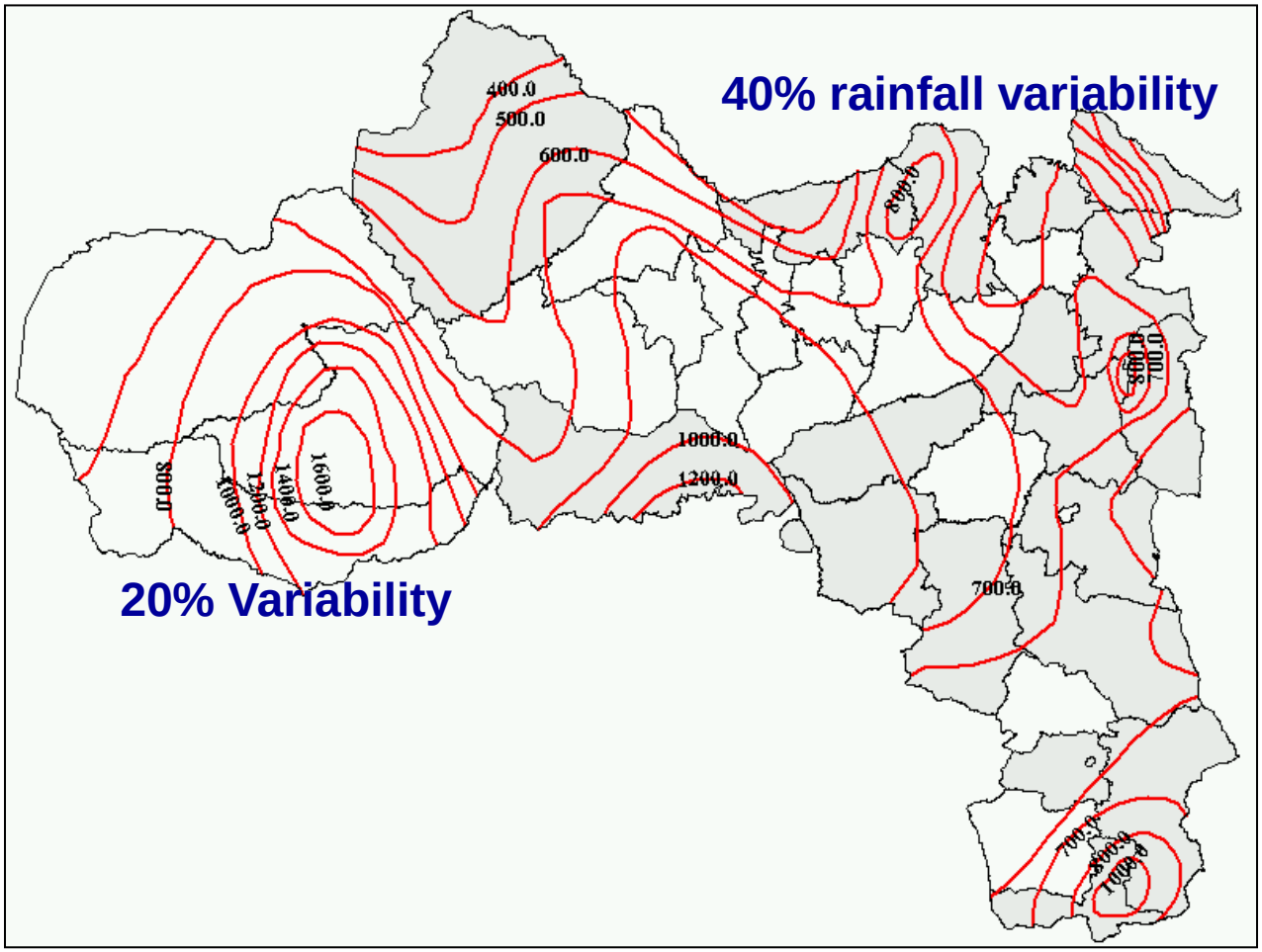


Population: about 5 Million.

Topography:
70% …… > 1500 m asl
40% …… > 2000 m asl

Rainfall of Tigray region:

- Main rainfall season: June to September.
- High spatial variability.



Mean Annual Rainfall in Tigray (mm) (Data: ENMA, 2012)

Major challenges of the Tigray region:

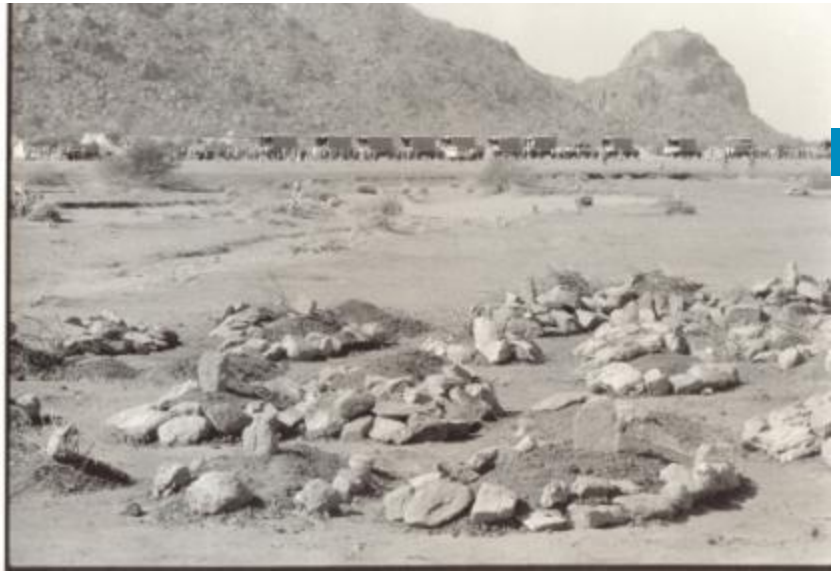
- Land degradation mainly erosion and reduction in soil fertility;
- Short rainy season coupled with high rainfall variability between seasons;
- Small land size that rarely exceeds 0.5 ha per family;
- Limited and/or absence of irrigation practices.

➢ ***All these factors contributed to food insecurity, droughts and even famine.***

Prior to 1990's

Photos: TBoARD archive data.

The final result of land degradation: drought and famine (TBoARD, archive)



Towards the Sunset

They trekked for **Weeks**
They trekked under **the Sun**
They trekked in **Darkness**
Walking towards **Sunset**
Leaving the **land of Sunrise**
Overwhelmed by **Disease**
Tortured by dusty **Wind**
No food to Eat
No water to Drink
No mountain to see
No trees to cool the Heat.

In memory of the displaced Tigryans, extracted from "A year in the death of Africa," Peter Gill

To reverse the situation, a number of programs have been implemented in the last two decades which include:

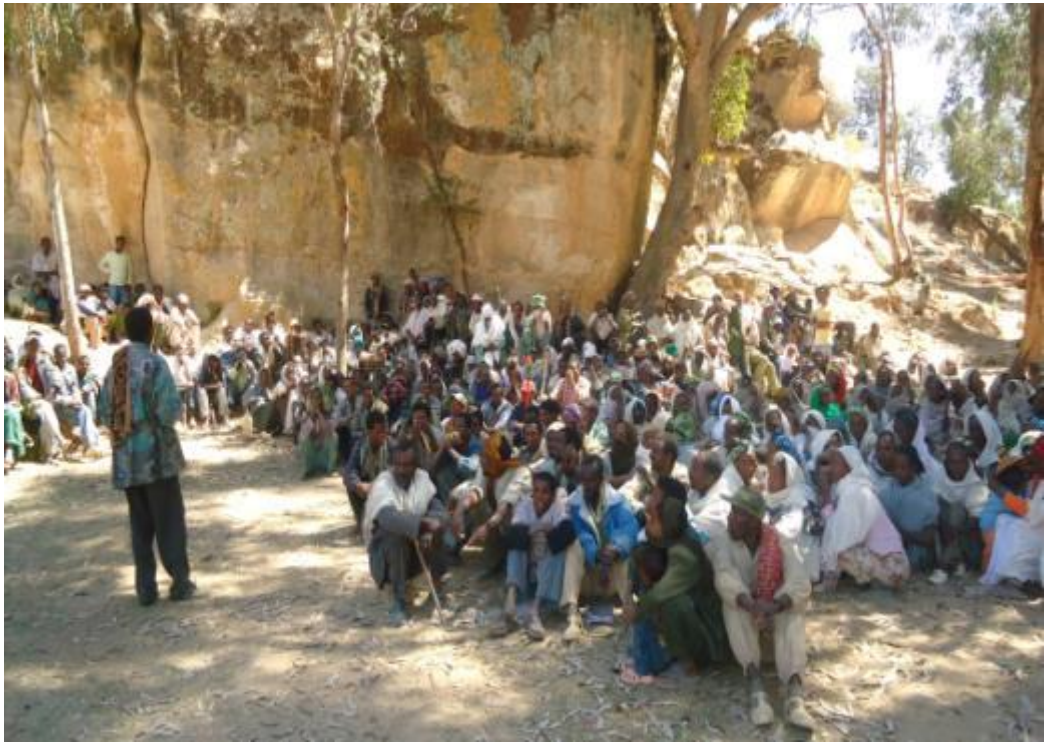
- **Watershed management**, and
- ***Water harvesting*** (surface and groundwater), and
- ***Irrigation development***.

3. Watershed Management

3.1 Approaches used for watershed management

Watershed management has been carried out in two public mobilized systems:

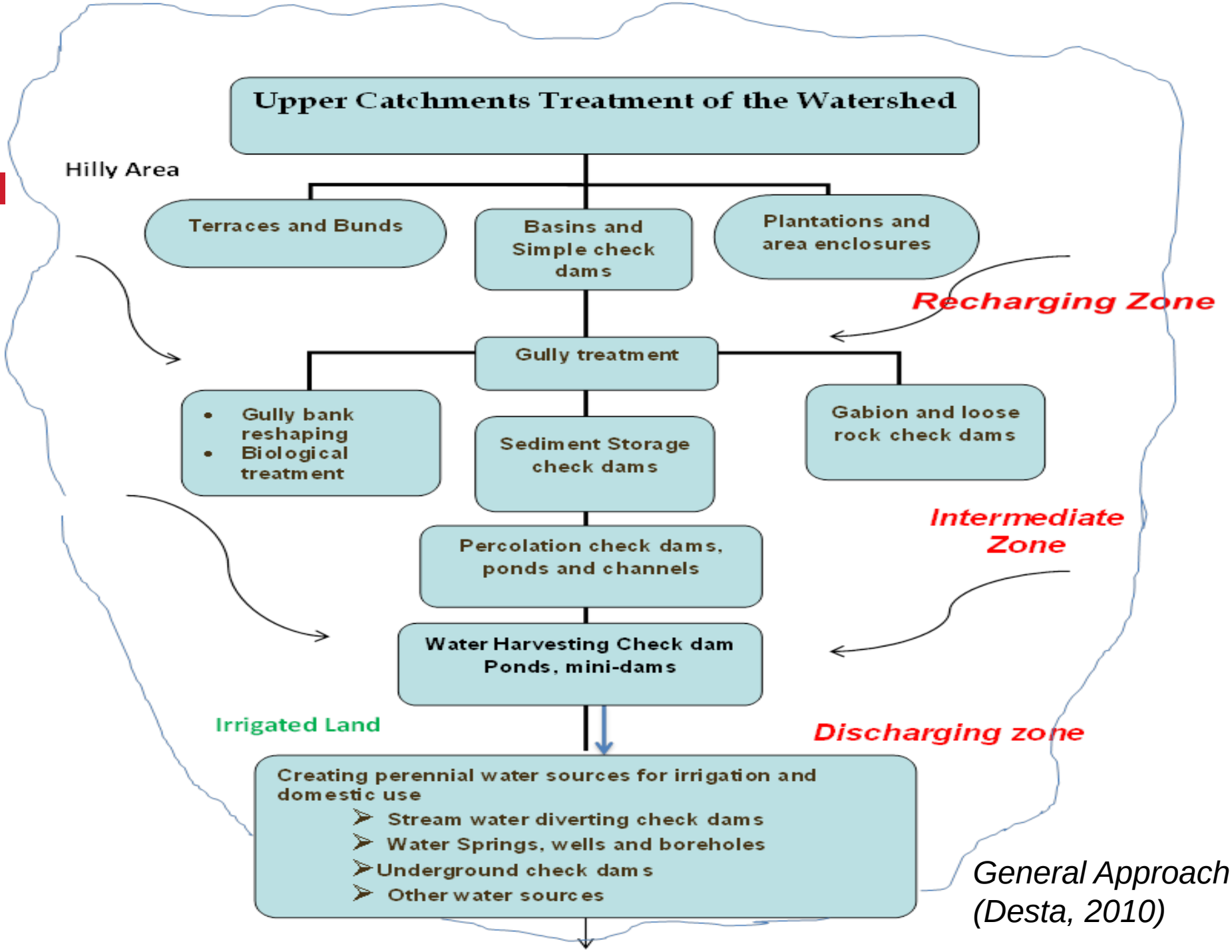
- **Free labour**: every member of a community who has “able body” spent 20-60 days per year in SWC activities free of any payments, and
- **Productive Safety Net Programs (PSNP)**: designed to provide employment for chronically food insecure people who have “able-bodied” labour.



(TBoARD, 2008)

3.2 Organization of Watershed Management

- Federal: develop national guideline and give strategic direction.
- Regional states: give trainings and support to Woredas.
- Woredas: give trainings and support to Kebele/Tabias.
- Kebele/Tabias (in coordination with Woreda): give training to sub-catchments.
- Farmers unions, women's associations, youth associations, schools, and religious institutions etc are involved in the planning and implementation of watershed management activities.



General Approach (Desta, 2010)

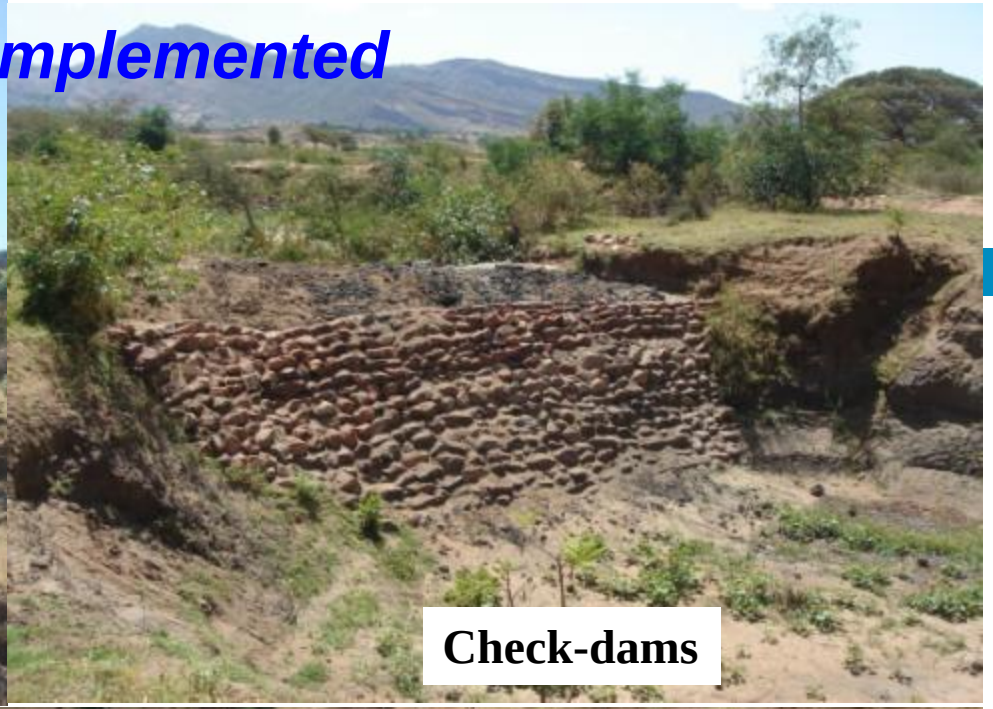
3.3 Status of watershed management

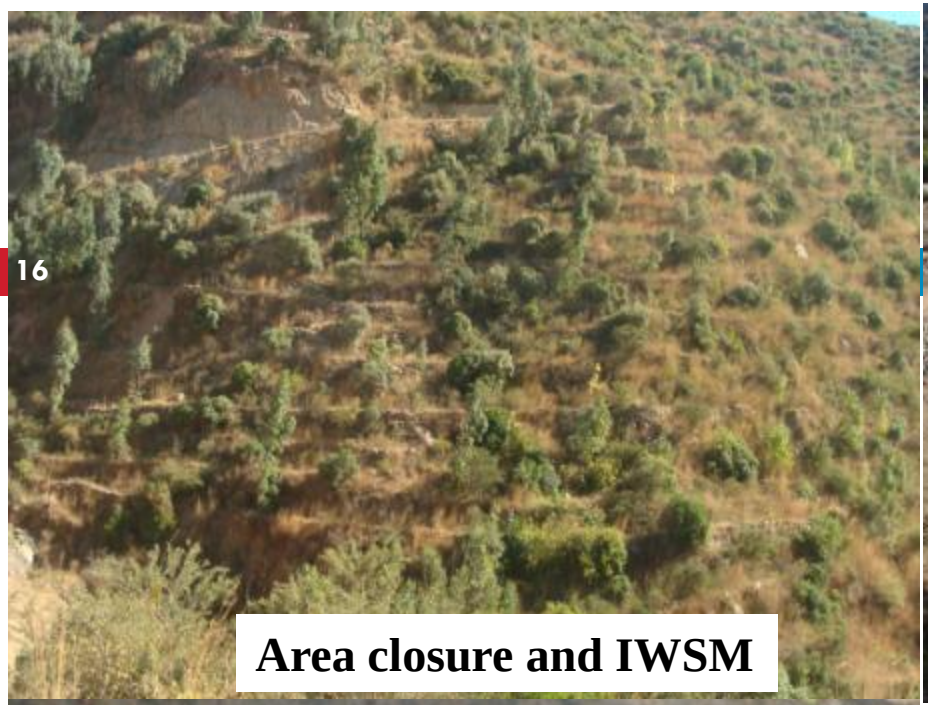
Different soil and water conservation, water recharging, and water harvesting structures have been constructed.

Coverage of SWC in Tigray:

- About 75% of the region is covered (TBoARD, 2014).

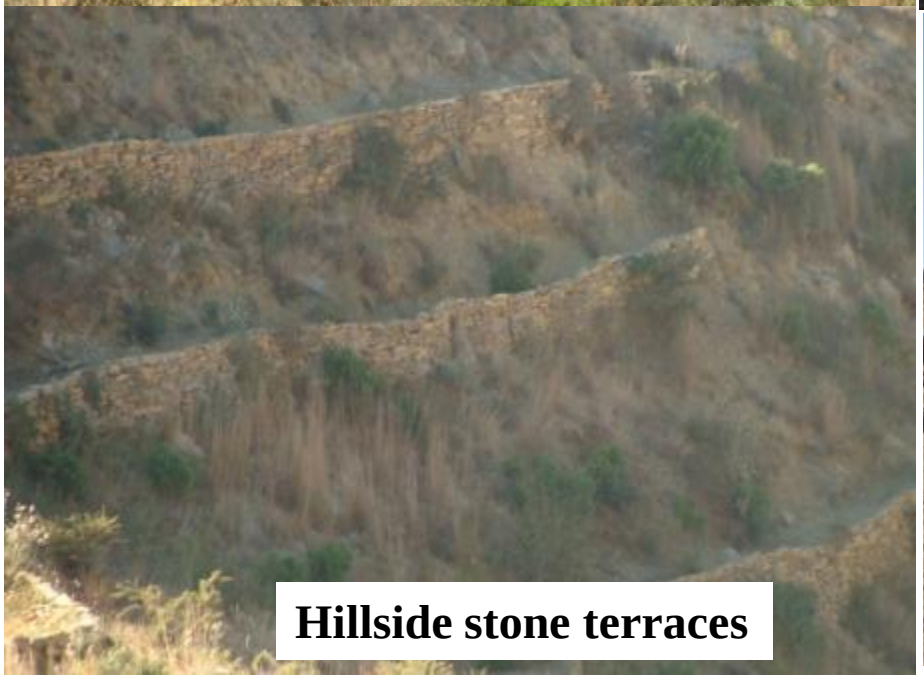
Some of the technologies implemented





Area closure and IWSM

Eyebrow basins



Hillside stone terraces

Stone bunds


Deep trenches


Contour ploughing and pits


Integrated gully treatment


Terraces

Examples of effective watershed management practices in Tigray implemented by REST (Desta, 2013)

3.4 Effects of watershed management

Hydrological benefits:

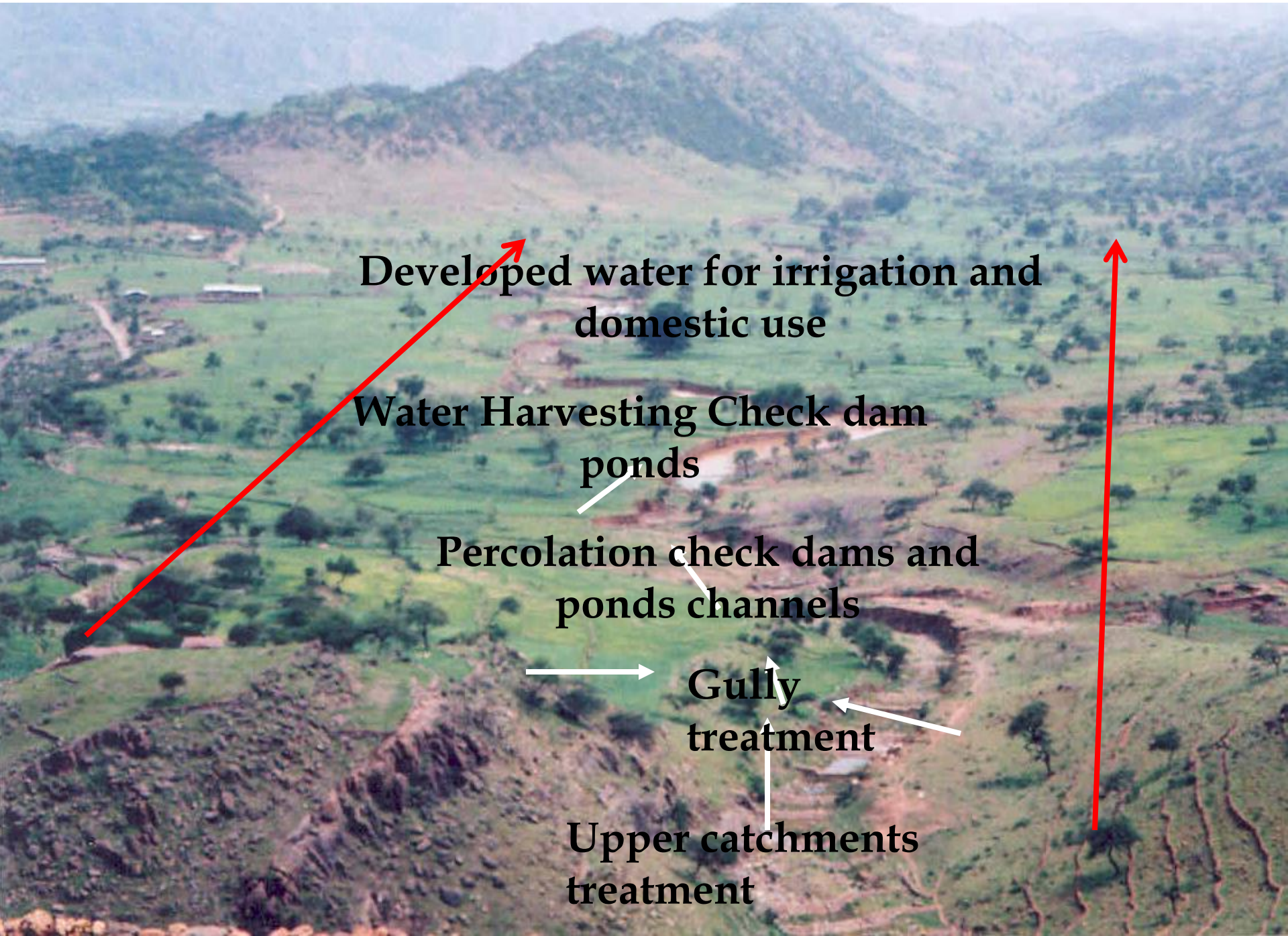
- Infiltration enhanced and moisture stress within the soil reduced.
- Flooding reduced and in many cases fully controlled.
- Sedimentation reduced.
- Groundwater improved (quality and quantity)
- New springs emerged and discharge of existing ones improved.

Abreha Weatsbeha area,
Tigray, Ethiopia

- Groundwater irrigation revolutionized in Tigray:
  - ➢ from less than 20ha in 1994/95 to over 45000ha in 2014.

(Woldearegay and Van Steenbergen (2014)

Example: Effective integrated catchment management (REST, Tigray)


Developed water for irrigation and domestic use
Water Harvesting Check dam ponds
Percolation check dams and ponds channels
Gully treatment
Upper catchments treatment

Examples of effective watershed management practices in Tigray implemented by REST (Desta, 2013)

Social learning is one of the major achievements

Typical examples of treated catchments that created new groundwater in Tigray, Ethiopia

Typical example of a landscape which:

- *created new water (surface and groundwater) at downstream areas.*
- *ceased flooding and associated sedimentation problems.*

Ahferom area, Tigray, Ethiopia

New groundwater created

- Groundwater improved (quality and quantity);
- New springs emerged and discharge of existing ones improved.

New springs created

A shallow well which used to dry shortly after the rainy season is now used throughout the year after the gully and catchment treatment was done.

Check-dam ponds used for groundwater recharge and surface water storage (Desta, 2013).

During construction

Typical Examples of Check-dam ponds used for:

- *Water storage,*
- *Groundwater recharge,*
- *Recreation?*

(Photo: TBoARD)

After construction

4. Techniques of Ex-situ Water Harvesting implemented in Tigray

4.1 Water harvesting using dams in Tigray

- Over 130 dams with heights between 9-45m are constructed in the last 20 years (by governmental and NGO's).
- Over 80000ha is irrigated using water from dams.

4.2 Construction of Check-dams in Tigray

A check dam is a vertical barrier constructed across a stream.

REST is the first organization who introduced the check-dam and check-dam pond technology in Tigray.

Use:

- Water storage (check-dam ponds).
- Sediment storage/gully rehabilitation.
- Groundwater recharge.

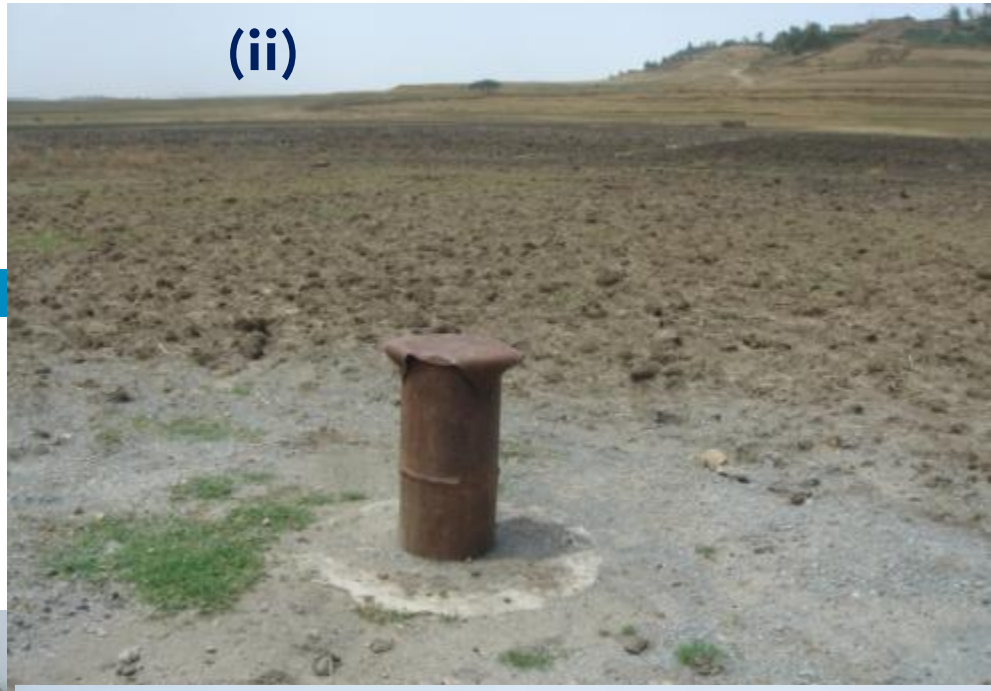
Some examples of the check-dams

Check-dam pond at downstream side of a river in Abreha Weastbeha.

Gabion check-dam (sediment storage) at upstream side of a river in Abreha Weastbeha.

4.3 Groundwater development

Hand-dug wells (i), shallow wells (ii), and deep wells (iii)



Percolation Systems at upstream areas in Abreha Weatsbeha, Tigray, Ethiopia

Hand-dug wells at downstream areas in Abreha Weatsbeha, Tigray, Ethiopia

4.4 River diversion weirs

4.5 Ponds (i, ii) and night storages (iii)

4.6 Pumping from rivers

4.7 Spate systems

4.8 Water harvesting from roads

Ponds used to collect water from culverts in Howane area, Southern Tigray, Ethiopia.

Series of Percolation ponds along the road, Hiwane, Southern Tigray, Ethiopia

Runoff from culverts contributing to the recharge of a hand-dug well in Wukro area, Tigray, Northern Ethiopia. Note the location of the culvert close to the vehicle.

A pond developed for harvesting concentrated flow from culverts in Shire area, Northern Ethiopia.

Partial view of series of gabion check-dams which are constructed at downstream of a bridge.

Concentrated runoff is channeled to these gabion check-dams in Bizet area, Tigray, Northern Ethiopia.

View of a borrow pit used for harvesting water in Axum area, Tigray, Northern Ethiopia.

The road embankment is now used as an earth dam and borrow pit as a reservoir. The size of the borrow pit that is storing water is 250m long, 80m wide, and with maximum depth of 15. It is used for small-scale irrigation (using pumps) and for shallow groundwater recharge in the area.

5. Benefits of Watershed Management and Water Harvesting

Benefits (noticed by all, including farmers):

- Infiltration enhanced and moisture stress within the soil reduced.
- Fertility of the soil improved.
- Flooding reduced and in many cases fully controlled.
- Sedimentation reduced.

A watershed with zero flood (Ahferom Woreda, Tigray, Ethiopia)

Dams which were constructed before catchments were treated have been suffering from siltation problems.

With proper watershed management the lifetime of our dams/reservoirs is improving.

- Groundwater improved (quality and quantity).
  - ➢ GW irrigation has become top agenda in Tigray region.
- New springs emerged and discharge of existing ones improved.
- New irrigation schemes started to be developed with the availability of water.
- Biodiversity is regenerating and wild animals are emerging.
- Micro-climate around the treated watersheds is improving.

A shallow well which used to dry shortly after the rainy season is now used throughout the year after the gully and catchment treatment was done.

Check-dam constructed to harvest stream flow:

- *A stream used to be dry during dry season (before ten years) is now used for irrigation in dry season (Adigudem area, Tigray, Ethiopia).*

- Enhancement of groundwater (recharge, and quality), and improvements in spring discharge.

Gumselasa dam and a groundwater well serving water supply for Adi Gudom town.

- Attitude of people towards natural resources management and irrigated agriculture is changing.
  - Migration to other areas (including middle east countries) is reducing.
  - One of the greatest achievements in the whole process.
- Livelihood of the people is improving and in some cases completely changing.
- Productivity has improved: up to 3 fold.
  - Food security is highly linked with water security.

Young generation of farmers are being created in the process

Irrigation development:

- Irrigation in Tigray has increased from less than 50ha in 1994/1995 to over 240,000ha in 2014.
  - Groundwater irrigation was about 20ha in 1994/95 but increased to over 45000ha in 2014.

Food security Vs water security:

- Water secured communities are food secured in northern Ethiopia.

6. Concluding Remarks

The experiences in Tigray demonstrates the following:

1. Despite a number of challenges (less fertile soil, highly variable rainfall, and highly degraded land) through integrated community owned watershed/natural resources management it is possible:
   - To ensure food security, and
   - To create an environment that is resilient to droughts/climate change.

2. Many of the soil and water conservation structures constructed in Tigray are non-engineered (constructed by local communities with some technical support by experts) and fully owned by the communities.

   - *This has contributed towards ensuring their sustainability and simplicity.*

3. The watershed management in Tigray evolved through trial and error, with no proper documentation, and more driven by decision makers.

   - ***Leaning: through doing and from failures.***

4. Integrated approach of landscape restoration coupled with appropriate water harvesting technologies is creating landscapes that are resilient to droughts, rainfall variability and climate change.

5. ***Social learning*** is the key to ensure sustainability and effectiveness of interventions.

Newly introduced Bench Terraces in Tigray

A hand-dug well which was productive before gully development is now dry because of the gully

Water security is all about land and water management

New groundwater created after the construction of a check-dam at downstream of the hand-dug well.

Quote: Community Leader (Champion)

Quote of local community leader named “Abahawi” (head Abreha Weatsbeha community, Tigray, Ethiopia)

“Our land is wise: it will treat us the way how we treat it”.


Let us be all Champions!